

# Predicting Ring deflections for Turning Processes

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The roundness of workpieces is of critical concern when producing components that must revolve at high speeds such as bearing rings. In turning operations, a key factor in producing round components is the influence of fixturing forces on the turned workpiece. In a typical turning operation, workpieces are clamped in chucks and collets, which impose localized forces causing elastic deformation of the workpiece. After turning, the workpiece is released from the fixture allowing it to relax elastically and the machined features to become out of round. This phenomenon is prominently observed in the machining of flimsy workpieces that are thin relative to their radius.

To extend the current capabilities of precision turning, the relationship between workholding forces and the deflection of a ring shaped workpiece is under investigation. A theoretical model for radial deflections incorporating point loading in the plane of the ring has been developed for rings that are very thin relative to their radius. A second model for rings of varying thickness is currently under development.

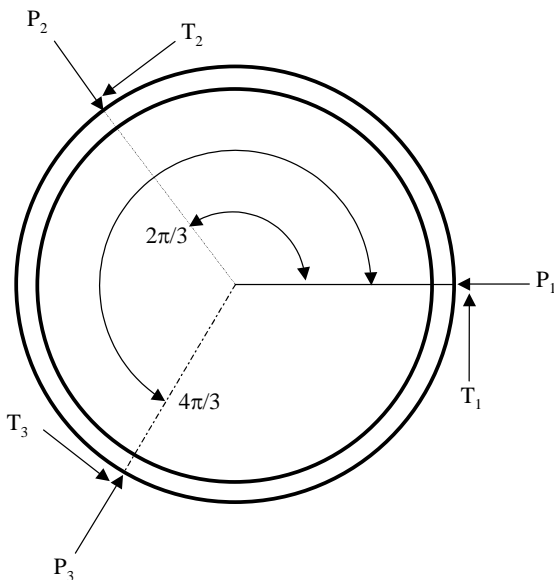
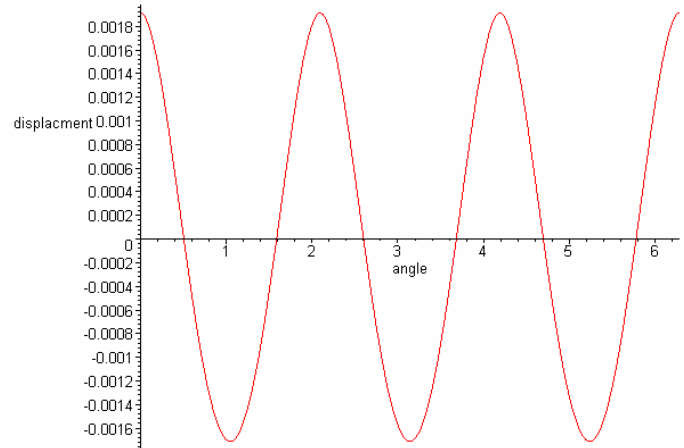


Figure of a point loading problem accommodated by current deflection models. The arrangement of forces is similar to those in a 3 jaw chucking arrangement.

To verify the validity of the theoretical models, ring deflection tests are currently being conducted. The ring tests involve clamping a rectangular cross section ring between a 60 degree V block and a hydraulic cylinder, which is very similar to external 3-Jaw

chucking. Rings of differing thickness are deformed and their radial deflection is inspected. The results of the experiment will determine the validity of the current deflection models and perhaps demonstrate the applicability of alternative models that are currently under development.



Plot of radial displacement versus angular position as predicted by theoretical model for the loading shown in the picture. The normal loads are 600 lbs, tangential loads are 0 lbs and are applied to a ring 4 inches in diameter,  $\frac{1}{4}$  inch in thickness and 1 inch in width..



John Malluck is a Masters student working on research in the area of fixturing technology for turning processes. He received his BSME degree from Georgia Tech in 2000 and began graduate studies at Tech the following fall. John expects to complete his masters degree Spring 2002 and then will begin working as an engineer in manufacturing industry.

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